Introduction

Immunization remains one of most cost-effective health interventions in recent years (Kandala, et al., 2007; Schaad, 1999). In spite of the improved interventions, increased overall resources and knowledge as well as history of the success that can be achieved, , there is a growing gap between what can be done to reduce child mortality and what is actually being done (Black at al., 2003). This is especially so of the developing and "refusing-to-develop" countries of which Nigeria is one. Although, over the years, a considerable amount of resources (human, materials and financial) have and are being expended by the government and donor agencies to provide support for the vaccination of Nigerian children, complete vaccination coverage remains a challenge. Presently, there appears to be a lack of comprehensive empirical documentation of the trends and patterns of vaccination use in Nigeria over time; at the same time, there is a need to appraise the level of utilization of immunization services provided in the past, to prepare for future challenges and improvements.

Nigeria, like many sub-Saharan African countries, continues to experience the slowest fall in mortality rate among children from vaccine preventable diseases – Nigeria is ranked 2nd overall, and 17th when ranked by under-five mortality rate (Antai, 2009). By this evidence therefore, Nigeria is at serious risk of not meeting the Millennium Development Goal (MDG) of reducing under-five mortality rate by two-thirds by 2015, from the base year of 1990. This is because vaccination in Nigeria has always faced multiple adversities (Jegede, 2007), with the most recent being the suspicion that immunization is an international conspiracy against selected communities, particularly those in developing countries to control fertility. As a result of these problems, Nigeria may have found it difficult to meet World Health Organization's (WHO) expected 90 percent complete vaccination coverage of children at the country level and 80 percent in sub-areas by the year 2010.

Generally, two major health service strategies are utilized complementarily: i) routine vaccination activities, performed by using a combination of mobile and fixed-point strategies or advanced strategies for remote villages; and ii) targeted campaigns, undertaken to complement routine activities and to avoid the emergence of specific epidemics (Sanou, et al., 2009). Besides these strategies, Rie (2004) has suggested the "risk based strategies" (who should be vaccinated?) and the "place based strategies" (where to vaccinate?). Other Strategies that enhance immunization coverage include approaches that improve demand for immunization, address access to immunization services, compulsory immunization, and adopt provider based strategies or a combination of these approaches is also possible (Pegurri, et al., 2005).

According to Black et al (2003), at least part of the explanation for the inability to reach a greater percentage of children with vaccines might be that the effort devoted to implementation has not been sufficient, especially in relation to strengthening health systems and changing key behaviours at the family and community level. In a multi-country assessment, Black (2003) showed that efforts to develop and implement activities to improve key family practices related to child mortality were limited, and those attempted took far longer and achieved much lower coverage than anticipated. In some countries, health worker training and community integrated management of childhood illness (IMCI) activities were being delivered to different communities, thus restricting the expected synergy. Often, programmes delivered many different messages simultaneously with low intensity, rather than concentrating on reaching high coverage with the few most relevant key messages in each context.

Methods

Four data sets from the Demographic and Health Survey for the years 1990, 1999, 2003 and 2008 for Nigeria were used for this study. These survey data were collected from nationally representative sample of households. Children under-five data files were utilized for this study. A formal request for the use of the data sets was made to ICF Macro, Maryland USA (the organization in charge of Measure DHS), which granted approval, thus, making it possible to download the requested data from its website. Sampling for the 1990 to 2003 surveys were carried out according to the zones while the 2008 survey used states as the sampling frame by using a probability proportionate to size. Due to the problem of over-sampling from any of the geo-political zones or the states, the study applied sampling weights, thus data analysis was carried out using the weighted sample.

The dependent variable for this study is *complete vaccination* coverage. For any child to be described as completely vaccinated the child must have received 3 doses of DPT and Polio vaccines, a dose each of BCG and Measles vaccines; this is what the surveys of 1990 through 2003 referred to as basic vaccination. However, the 2008 survey included 0 dose of OPV and because this was not in the previous surveys, it was excluded from the analysis. To be fully vaccinated for poliomyelitis and diphtheria, pertussis and tetanus, the child must be given 3 doses of each vaccine. As widely used and recognized by the World Health Organization (WHO), the child's health card and mother's recall were the criteria used to ascertain that a child had been vaccinated. Inasmuch as this method seems to be a viable option, it is still open to error: the inability of the mother to show a child's vaccination card or recall that the child had been vaccinated may result in under- or over-reporting of vaccination. This can be especially true of people or communities that patronize the traditional health care or depend on home delivery or management of illnesses. At the same time, because respondents may want to appear socially desirable, those who do not have health cards are likely to report or "recall" having vaccinated their children. Independent variables included in the study are sex and age of the head of the household, maternal level of education; geopolitical zone and year of survey, type of place of residence; sex and current age of the child, whether the child was delivered in the hospital or at/in homes, and whether the mother of the child works at home or away from home.

Both descriptive and inferential statistics were deployed in data analysis. Data were cross tabulated at the bivariate level to describe respondents' characteristics vis-à-vis key dependent variables like vaccination for BCG, measles, DPT, OPV and those who had received all basic vaccination. Logistic regression was used to build a model to predict the children with the most likelihood of being immunized and those for future immunization targets as "hot areas". At the multi-variate level, fully vaccination coverage was categorized into two: "no or incomplete vaccination" versus "complete vaccination" for a binary logistic regression analysis. For comparability, only items found in all four surveys years were used. Thus, some important issues like frequency of media use and OPV 0 dose were excluded from the analysis because they were not included in the instrument for the survey prior to 2003 and 2008.

Results

There were a combined total of 44071 (weighted) children in the four surveys with the 2008 survey contributing 61.2 percent (26976), 1990 had 7794 children (17.7 percent); 2003 had 5937 or 13.5 percent and 1999 survey with the least number of children having 3360 or 7.6 percent. More than half the respondents in the 2003 (56.2 percent) and 2008 (50.7 percent) surveys had no health cards compared to those in 1999 and 1990 with 38.6 and 41.0 percents, respectively.

It is obvious that there was better immunization coverage for under-5 children in Nigeria in the years (five) preceding the national demographic and health survey of 1990 (table 1). In the 1990 survey some 24 percent of under-5 children received all basic vaccines compared to the 9.5 percent covered 13 year later in 2003. On the basis of this data, no progress had been made. It is more painful that the situation does not depict stagnation but retrogression, implying that by the time the rest of the whole would have eliminated virtually all the vaccine-preventable childhood illnesses, Nigeria will still remain a potent reservoir from which these diseases will spread to all parts (Pallansch and Sandhu, 2006), thus making the effort to eradicate childhood killer diseases unsuccessful. There was an improvement on 1990 and 1999 in the 2003 survey because since 1997 NPI repeatedly conducted regular rounds of immunization days.

Some of the variables that showed significant relationships at the bivariate level were not significant at the logistic regression and were thus, excluded from the model as shown in table 2. For example, vaccination status of children was not dependent on the gender of the household head as there is no statistically significant difference ($p > 0.05$) between male- and female-headed households with respect to vaccination of under-5 children (Table 5). However, using the education of the mothers as a measure for completeness or incompleteness of vaccination and making mothers with 'no formal education' as the reference category, data revealed statistically significant differences (at P = 0.01) between children whose mothers were educated at the primary, secondary and tertiary levels. The level of complete vaccination increased with the level of maternal education. Similarly, children in urban residence had about 2 times (OR = 1.772, CI = 1.649 to 1.905) of being fully vaccinated with all basic vaccines compared to those resident in the rural areas. Children who were delivered in hospitals (p=0.004) and other places (p=0.008) have higher odds of being vaccinated than those delivered at/in homes (homes was defined as the respondents' houses or homes of traditional birth attendants).

Table 1: Proportion of Children who received all Basic Vaccination by selected characteristics according to the year of survey

Selected characteristics	**Completed Basic Vaccination**				**All surveys**
	1990 **(N = 7796)**	1999 **(N = 3360)**	2003 **(N = 5938)**	2008 **(N = 26978)**	
Sex of Household Head					
Male	23.2	12.1	9.1	15.7	**40363**
Female	28.7	15.4	13.2	22.3	**3708**
Geo-political Zone					
North east	32.3	5.4	11.6	19.3	**7602**
North west	38.5	4.8	6.0	5.2	**7906**
South east	12.4	16.7	3.0	4.7	**13369**
South west	14.2	20.0	25.8	30.2	**5572**
Central	NA	15.0	16.0	25.1	**4800**
South-south	NA	NA	21.9	32.7	**4822**
Place of Residence					
Urban	41.4	21.9	16.3	27.5	**12343**
Rural	18.8	8.7	6.7	11.5	**31728**
Level of Maternal Education					
No Education	15.2	5.0	3.2	4.9	**22359**
Primary	32.1	13.3	12.2	17.8	**10400**
Secondary	49.5	22.9	20.2	30.3	**9470**
Higher	64.4	36.4	20.5	45.8	**1843**
Current Age of Child in years					

0	5.1	3.4	2.5	6.0	**9659**
1	28.3	17.0	13.5	22.8	**8339**
2	33.3	20.6	14.1	22.8	**7751**
3	34.0	NA	13.7	20.7	**7318**
4	30.8	NA	12.6	19.9	**6684**
Mother work at home or away					
At Home	22.3	15.6	8.2	12.6	**13710**
Away	29.6	19.2	15.2	24.3	**15495**
Place of delivery					
Homes	13.8	6.3	4.6	7.4	**27675**
Hospitals	43.0	22.4	19.7	32.0	**14999**
Others	NA	20.0	4.8	27.5	**587**
Total	**23.5**	**12.4**	**9.5**	**16.3**	**44071**

Table 2: Logistic Regression Modelling Complete and Incomplete/no Vaccination of Under-5 by Selected Characteristics

Selected characteristics	**Odds ratio**			
	1990	**1999**	**2003**	**2008**
Place of Residence				
Rural	**RC**	**RC**	**RC**	**RC**
Urban	**0.515*** **	0.414***	0.636***	.773***
Level of Maternal Education				
No Education	**RC**	**RC**	**RC**	**RC**
Primary	1.416***	1.194	2.478***	2.686***
Secondary	1.921***	1.706*	3.635***	3.758***
Higher	2.813***	1.791	3.784***	5.066***
Current Age of Child				
0 year	**RC**	**RC**	**RC**	**RC**
1 year	9.101***	7.015***	5.542***	5.960***
2 years	11.145***	6.337***	6.825***	5.626***
3 years	11.236***	-	7.060***	5.277***
4 years	9.257***	-	7.096***	4.878***
Mother work at home or away				
At Home	**RC**	**RC**	**RC**	**RC**
Away	**0.903**	1.103	1.285*	1.352***
Place of delivery				
Homes	**RC**	**RC**	**RC**	**RC**
Hospitals	2.174***	2.079***	2.049***	2.430***
Others	-	1.536	0.404	1.945***
Geopolitical zones				

North	**RC**	**RC**	**RC**	**RC**
South	1.475***	0.944	1.086	.961

RC = reference category; * significant at 0.001; ** significant at 0.01; * significant at 0.05**

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